

**WHAT IS CLAIMED IS:**

1. A form, fill and seal packaging machine for forming, filling and sealing a carton, the machine configured to mold a closure directly onto the carton, the machine comprising:
  - 5 a carton erection station, the carton erection station adapted to receive a carton in a generally flat form and erect the flat form carton into a tubular form defining an internal carton region;
  - 10 a direct injection molding station having an internal mold tool and an external mold tool, the internal mold tool configured for receipt within the internal carton region, the internal mold tool and the external mold tool configured to receive and clamp the carton therebetween, the direct injection molding station further including a polymer injection system for injecting polymer from a location external of the carton to the internal mold tool, wherein a closure is directly molded in place on the carton;
  - 15 a filling station for filling the carton; and
  - a sealing station for forming a seal on the carton.
2. The form, fill and seal packaging machine in accordance with claim 1, wherein the internal tool is fixedly mounted and wherein the external tool is configured to move between a first position in which the external tool is disengaged from the internal tool and a second position in which the external tool is engaged with the internal tool with the carton disposed therebetween.
3. The form, fill and seal packaging machine in accordance with claim 2, wherein the external tool is formed having first and second portions configured to move toward one another when the external tool moves to the second position, and away from one another when the external tools moves to the first position.
4. The form, fill and seal packaging machine in accordance with claim 1, wherein the polymer injection system includes a charging cylinder and an

injection cylinder in series with one another, the charging cylinder providing a feed of polymer to the injection cylinder, and wherein the charging cylinder and the injection cylinder are in opposed relation to one another.

5        5.     The form, fill and seal packaging machine in accordance with claim 4 wherein the polymer injection system includes a sprue bushing in flow communication with the injection cylinder and a needle reciprocable within the sprue bushing for initiating and terminating flow of polymer.

10        6.     The form, fill and seal packaging machine in accordance with claim 1, wherein the internal mold tool includes cooling channels.

7.     The form, fill and seal packaging machine in accordance with claim 6, wherein the cooling channels are formed having a V-shaped configuration.

15        8.     The form, fill and seal packaging machine in accordance with claim 1, wherein the direct injection molding station includes a frame mountable to the packaging machine, and wherein the frame includes a mandrel on which the carton is mounted during molding of the closure.

20        9.     The form, fill and seal packaging machine in accordance with claim 8, wherein the internal mold tool is mounted to the mandrel.

25        10.    A direct injection molding station for use on a form, fill and seal packaging machine for forming, filling and sealing a carton, the molding station being configured to mold a closure on a predetermined portion of the carton, the molding station comprising:

30        a frame;  
              a fixed mold tool carried by the frame, the fixed tool having cooling channels formed therein in flow communication with channels formed in the frame

for supplying a coolant to the cooling channels;

a movable mold tool carried by the frame, the movable mold tool being movable between a first position wherein the movable tool is disengaged from the fixed tool and a second position in which the movable tool is engaged with the fixed tool with the carton disposed therebetween;

5 a polymer injection system including a polymer flow conduit for providing polymer from a location external of the carton to the fixed tool, wherein a closure is directly molded at the predetermined portion of the carton.

10 11. The direct injection molding station in accordance with claim 10, wherein the cooling channels in the fixed tool are formed having a V-shaped path.

15 12. The direct injection molding station in accordance with claim 11, wherein the fixed tool includes a bore for receiving the polymer flow conduit and wherein the polymer flow conduit is formed in the fixed tool centrally of the V-shaped path.

20 13. The direct injection molding station in accordance with claim 10, wherein the polymer injection system includes a charging cylinder and an injection cylinder in series with one another, the charging cylinder providing a feed of polymer to the injection cylinder, and wherein the charging cylinder and the injection cylinder are in opposed relation to one another.

25 14. The direct injection molding station in accordance with claim 13, wherein the polymer flow conduit is formed at a discharge side of the injection cylinder.

30 15. A mold tool set for directly molding a closure to a package material, the mold tool set being in flow communication with a polymer injection system for providing polymer to the mold tool set, the mold tool set being positioned within a

frame in a form, fill and seal packaging machine, comprising:

a fixed mold tool carried by the frame, the fixed tool having cooling channels formed therein in flow communication with channels formed in the frame for supplying a coolant to the cooling channels; and

5 a movable mold tool carried by the frame, the movable tool being movable between a first position wherein the movable tool is disengaged from the fixed tool and a second position in which the movable tool is engaged with the fixed tool with the package material disposed therebetween,

10 wherein when the fixed tool and the movable tool are engaged with one another a mold cavity is formed corresponding to the closure, and wherein the fixed mold tool has cooling channels formed therein in flow communication with a coolant source for supplying a coolant to the fixed tool.

15 16. The mold tool set in accordance with claim 15 wherein the cooling channels in the fixed tool are formed having a V-shaped flow path and wherein the fixed tool includes a bore for receiving a polymer flow conduit and wherein the polymer flow conduit is formed in the fixed tool centrally of the V-shaped flow path.

20 17. A direct injection molded closure formed on a package material, the package material being in an open top and open bottom tubular form, the closure being formed on a top panel of the package material, the closure comprising:

a base portion integrally molded to the package material, the base portion forming a connecting flange;

25 a spout portion extending upwardly from the base portion;

a cover configured to form a seal at the spout; and

a tamper-indicating member formed integral with the cover, the tamper indicating member formed as a frangible member integral with the cover that is broken upon initial opening of the closure.

18. The closure in accordance with claim 17 wherein the tamper-indicating member is formed as a tab extending from the cover and having a terminal portion molded to the package material spaced from the base portion.

5 19. The closure in accordance with claim 17 wherein the flange is molded to the package material at an opening therein defined by an edge, and wherein the flange portion encapsulates the edge.

10 20. A method for forming a closure on a carton blank in a tubular form, the carton blank formed from a composite material having a polymer layer on at least one side thereof, the method comprising the steps:

providing a fixed mold tool defining a portion of a mold cavity therein, the mold tool being in flow communication with a polymer injection system;

15 positioning the carton blank adjacent and engaged with the internal tool, the carton blank being in an at least partially erected state having a tubular form;

providing a movable tool defining another portion of the mold cavity therein, the fixed tool mold cavity and the movable tool mold cavity defining a desired closure configuration;

20 engaging the movable tool with the carton blank on an opposing side of the carton blank from the internal tool to form the mold cavity;

pressing the movable tool to the carton blank and the fixed tool;

injecting a polymer into the mold cavity to form the desired closure; and releasing the closure from the mold cavity.

25 21. The method in accordance with claim 20 including the step of positioning the carton horizontally and moving the carton in a horizontal plane to engage the internal tool.

30 22. The method in accordance with claim 20 including the step of injecting the polymer into the mold cavity from a position internal of the carton.

23. The method in accordance with claim 20 including the step of engaging the movable tool with the carton blank so as to overly an opening in the carton blank.

5

10

24